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COMMUNICATIONS NEWSLETTER

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
ELECTRONIC COMMUNICATION STAFF
DENVER SERVICE CENTER



JUL

1976

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FROM THE EDITOR:

America's bicentennial celebration signifies more than just a period of existence. Without the ingenuity and motivation of her people, there probably would not even be an America, not to mention a bicentennial, to celebrate. During these past 200 years, phenomenal advances in every technology have produced a way of life that most of us take for granted. Even the "good old days" are overshadowed by these technological advancements.

The communications field has been a front runner in regards to these advancements. With each oncoming year, a need for better communications develops. Americans have responded to these needs and, as a result, have produced the world's finest communications system.

In honor of the bicentennial, the following brief history is included to guide you through America's phenomenal advances in communications--advances generated by her need to communicate better, faster and more efficiently.

With the advent of "electricity" it didn't take long for someone to improve on the previous methods of haphazard and unreliable long distance communications. In 1835 two Americans named Alfred Vail and Samuel Morse used the process of "electricity" to invent the "telegraph." That same year Morse sent the first historic telegraph message, "What hath God wrought," from Washington to Baltimore. By 1866 Western Union had 74,570 miles of telegraph wire up and America was connected to Europe via the Atlantic Cable!

Ten years later in 1876 Alexander Graham Bell further advanced communication by saying his now famous sentence, "Mr. Watson, come here, I want you!" over a variable resistance transmitter.

A year later 778 telephones were in operation. By 1900 there were 855,900 telephones under the Bell System . . . and there were over 700,000 telephones being operated by over 5,000 independent telephone companies. Ten years later, in 1910, America had 12,300 telephone companies competing against each other. Today, 100 years later, there are approximately 1,641 private companies with 25,826,000 operating telephones while the Bell companies operate 118,146,000 telephones.

In 1888 an American college professor, Amos Dolbears, successfully sent the first radio waves through the air. Dolbears, using a kite with an attached wire for an antenna, was able to transmit understandable speech over a distance of a half mile. The transmitter he used was an old receiver from a Bell telephone and a homemade microphone.

But as it was, an Italian teenager named Guglielmo Marconi was also experimenting with wireless transmissions in Italy. By implementing the works of such giants as Galvani, Volta, Oersted, Faraday, Hertz, Edison

and others (including the experiments of Ben Franklin and the "induction at a distance" discoveries of the American physicist Joseph Henry), Marconi developed his own homemade wireless set.

Just a few years later, in 1898, Marconi transmitted a code across the Atlantic. From his tower antenna in England to his antenna (a kite) in Newfoundland, Marconi was able to transmit the Morse Code "S." This marked the coming era of wireless telegraphy in America.

With the success of wireless transmissions of coded messages, many men immediately began to improve on the system. One of those men was an American professor at the University of Pittsburg named Reginald Fessenden. In 1905 Fessenden found a way to transmit a continuous wave on which voice was superimposed as modulations. Now there was a communications system capable of transmitting understandable speech through the air!

At about this time another American, Lee deForest, perfected a triode that was able to multiply electric current billions of times and made quality broadcasting possible. deForest named the triode his "Audion." With this invention began the "golden age of radio," and America was to be connected coast to coast with "sound."

Twenty-five years later in the USA there were 2,805 commercial radio stations on the air, 691 of them FM. Today there are approximately 4,436 AM and 3,398 FM stations on the air and an estimated 400 million radios in use in the USA!

In 1919 almost immediately after the initial discoveries in wireless voice transmissions, a Russian refugee named Valdimir Zworyhin developed the cathode ray tube. He took his invention to RCA, who hired him to develop his work further. By 1939 RCA demonstrated "television" at the New York World's Trade Fair.

At the end of World War II there were nine commercial television stations on the air and 7,500 sets in use. By 1955 there were 411 commercial TV stations and 11 noncommercial TV stations on the air. Today there are 706 commercial stations and 147 noncommercial stations. And there are 121,000,000 television sets in operation in the United States!

The crowning achievement, though, in American communications has, of course, been in the transmitting of all three mediums--telemetry, voice, and pictures--through space. The successful Apollo XI mission represented this major achievement in incorporating high capability and reliability into lightweight, compact communications systems.

This brief history summarizes the major advancements in communication. With each of these major advancements comes many improvements--improvements leading up to the present state-of-the-art. When the need occurred, American ingenuity responded.

For example, why limit communications to cities and home? Communications were needed to reach people wherever people were. This need resulted in the portable "lunch-box" size mobile radios in the mid-fifties. This radio found many uses in America. Yes, even including fighting forest fires. Even though these radios were small in comparison to other radios of the times, a need existed for even better portability. This gave rise to the "brick-size" portable radio of today. Similarly, as a result of other needs, repeaters, base stations, duplexers, microwave, etc. were developed.

Today, the need for better communications is as great as ever. Worldwide communications in the form of communications satellites, tethered balloons, meteor-burst communications, etc. are all being developed. And there's more to come--faster facsimile, fiber optics, and a host of new communications tools.

PERSONNEL

The newsletter would like to take this opportunity to extend a hearty welcome to the following Bureau employees.

Douglas P. Dickinson (Alaska)

Douglas joined BLM in November 1974 as an electronics technician. His primary duties include field survey communications and EDM maintenance and support.

He previously spent 15 years working as a Broadcast Engineer at radio/TV stations, including KYAD in Anchorage, KIAK in Fairbanks, and KCST in San Diego.

Douglas graduated from high school at Sheldon Jackson High School at Sitka, Alaska. He acquired advanced college credits at Sheldon Jackson Junior College, San Diego State College, and San Diego City College.

Richard Ray Soto (Alaska)

In 1973 Richard changed professions from construction to electronics. He then joined BLM in 1974 and is working as an Electronics Technician in the Cadastral Electronics section. Richard's duties include supporting remote survey camp communications and EDM (Electronics Distance Measuring Equipment).

A. Ted Spindler (Alaska)

Ted was assigned as Chief of the Cadastral Electronics Section in August of 1975. He had previously served varied assignments in BLM Fire Control and in Office of Aircraft Services, USDI.

Prior to joining the Bureau in 1971, he was employed with North American Rockwell for sixteen years. Ted's military service included active duty in three branches--Army, Air Force, and Marine Corps, and with Navy Reserve affiliation at the present time.

He graduated from high school in Carlton, Minnesota, with college credit received from Fullerton and Santa Ana Colleges in California.

Carlos V. Rangel (ECS, DSC)

Carlos joined BLM in January of 1976. He is presently working as an Engineering Aide for the Electronic Communications Staff.

Since graduation from high school at Cheraw, Colorado in 1967, Carlos has served in the U.S. Army and is presently enrolled as a senior in the Applied Math and Electrical Engineering program at the University of Colorado.

Carlos supplements his formal schooling at CU with on-the-job experience with ECS.

FROM ECS

Jerry Reichmuth and Gordon Thayer both passed away recently. Jerry was a civil engineering technician who assisted in Bureau communication activities in the California SO. Gordon was the Bakersfield District system technician. Both Jerry and Gordon left behind deep impressions of respect and love in the people who knew them. Their absence will be long felt.

Contrary to public belief, the concept of a reliable simplex telephone auto-patch system is not dead. The ECS recently had the opportunity to observe the operation of a newly manufactured system. Of all the systems examined to date, this one appeared to be of the best design. However, various factors indicated that problems may still exist in the overall simplex operation. Discouragement, though, is not in order. With each new system examined, fewer operating problems are encountered.

FROM DSC PROPERTY MANAGEMENT

Art Kron, Chief, Personal Property Section, has indicated to the newsletter a way in which the States can earn more money from their radio disposals. Art has incorporated this information into the following article.

HOW TO EARN MORE MONEY FROM YOUR RADIO DISPOSALS

During the past year BLM disposed of 197 replaced radios having an acquisition cost of \$150,000. All of these radios were transferred to the Federal Aviation Administration without reimbursement.

Radios are eligible to be traded in on new purchases of similar items and to be reported to and sold by GSA under the exchange/sale authority. The proceeds become available for obligation for the purchase of new similar replacements.

Our disposal records indicate that proceeds received from the sale of radios in operating condition amount to 15 percent of acquisition cost. If all the 197 radios had been in operating condition and had been sold or transferred with reimbursement, BLM would have realized approximately \$22,500 which could have been obligated for the purchase of similar new radios.

Approval has been requested and received to negotiate transfers of eligible exchange/sale property on a reimbursable basis to Federal agencies other than Interior agencies. Transfers within the Federal Government take precedence over exchange/sales. Fifteen percent of acquisition cost is the amount BLM will charge for reimbursable transfers. However, if the percentage of return from sales increases, the charge for reimbursable transfers will increase accordingly to the same percentage realized from sales by GSA.

As an illustration of obtaining increased proceeds through reconditioning, GSA Region 8 Motor Pools perform a significant amount of reconditioning involving the expenditure of up to 10 percent of the estimated sale value. This effort enables them to average a 40 percent of acquisition cost return from the sale of their fleet vehicles in the one tone and under classes.

In order that BLM can increase the returns from the sale of replaced radios, we urge that you devote up to one hour of labor and install minor parts, if required, to place the radio in the best possible condition for sale.

Upon receipt of the proceeds at the Denver Service Center, the Branch of Property Management, D-522, arranges for the crediting to the state, activity and work job code 0200, as indicated on the equipment budget, for obligation for the purchase of new similar replacements.

FROM CALIFORNIA

Ken Alexander has sent us some information on a new product from Speedcall Corporation. The new identity display device, Model 422 display, provides automatic identification of callers with up to seven LED digits. The unit also provides an audible and visual alarm of emergency calls. The Model 422 is designed for use on radio, wireline, and microwave circuits using touch-tone signaling. The unit features an operating signaling speed of 20 digits per second (adjustable); the unit will receive and display a full seven-digit ID in less than 0.4 seconds. The 422 is available with outputs for computer and hard copy printers and automatic number identification encoders are available for modules and remote or alarm sites. For more information, write Speedcall Corporation, 2020 National Avenue, Hayward, California 94545.

PRODUCT BRIEFS

- Design and Maintenance of Two-Way Radio Systems

At the end of this issue is an article with a few suggestions on what not to do as you design and maintain two-way radio systems.

The article, "Ounces of Prevention," is taken by permission from the IEEE Vehicular Technology Group (VTG) Newsletter. It was written by Mr. A. K. Guthrie who, in addition to being the VTG Newsletter's Communications Editor, is the Manager of Product Service Engineering for General Electric at Lynchburg, Virginia.

- Technical Information

We also have included at the end of the newsletter two technical information bulletins and one informational handbook from Decibel Products, Inc., of Dallas, Texas. The booklet, "About Lightning," presents a nontechnical presentation about a rather technical subject. The bulletins "Application and Theory of Cavities and Duplexers" and "Cavities and/or Ferrites: Their Practical Use in Combiners and Multi-couplers" contain some very informative articles.

- Sinclair is now on a GSA contract.

- CTCSS

Pulse Engineering has sold its microcircuit operation (this includes the tone-squelch module PE 86022) to Custom Devices, Inc., Phoenix, Arizona. Their address is: P.O. Box 3139, Tempe, Arizona 85281. Phone: 602/268-1371.

COMMUNICATIONS IN 1984:

Due to the spectacular growth of the communications industry, it seems that all past predictions of communications growth have fallen quite short of what actually happened. Everyday breakthroughs in IC designs and miniaturization advances the state-of-the-art. What are some of the predictions for 1984? How do they compare with 1974?

	1974	1984
Two-way transmitters	10 million	20 million
Computers in use	80,600	285,000
Data terminals	960,000	7 million
Facsimile sets	145 million	203 million

Already these predicted figures are showing signs of being quite conservative. One thing for sure, in this age of electronics, predictions are hard to predict.

OUNCES OF PREVENTION

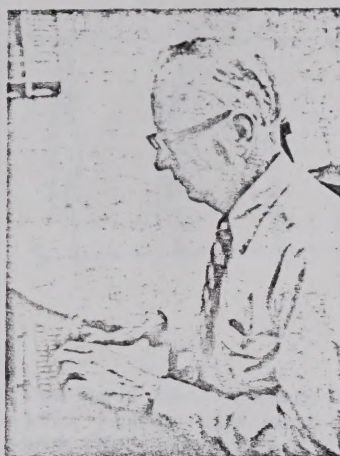
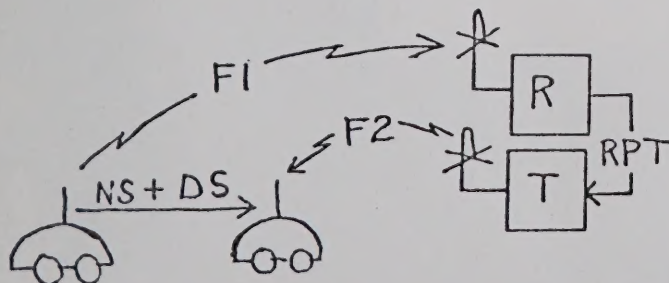
By A. K. "Kenny" GUTHRIE
COMMUNICATIONS EDITOR

"There's only a thin line between fame and notoriety!" Do something constructive with a radio system and you're famous--at least with people who know what goes on. Foul it up, and you're instantly notorious. Assuming you'd like to avoid becoming notorious, here are a few negative suggestions. These are things you shouldn't do--mistakes you should not repeat--as you design and maintain two-way radio systems.

1. DON'T CHOOSE 179.9 Hz as a CTCSS (Tone Squelch) frequency if you're in an area served with 60 Hz power. Sure, 179.9 Hz is listed as assignable in EIA RS-220, but that doesn't make it good. The third harmonic of the 60 Hz power frequency can "trip" your decoder. If ripple in your own station does not do the job, we can recover 180 Hz from the power supply or a telephone line at a undesired distant station. 123.0 Hz (which gets close to the second harmonic of 60 Hz) isn't nearly so bad, but why tempt fate? If you're in an area served by 50 Hz power, you should avoid 151.4 and 100.0 for the same reasons.

2. DON'T CHOOSE low tone squelch (CTCSS) tones when you have a viable alternative. All other things being equal, decoder pickup time varies inversely with tone frequency. It takes twice as long to decode 71.9 Hz as to decode 141.3 Hz. It's better to lose the first syllable than to lose the first word!

3. DON'T PRECLUDE car-to-car communication by your efforts to improve it. When one needs to communicate mobile-to-mobile beyond the limits for direct transmission, a repeater is the logical tool. The desired path is from one mobile (on F1) to the repeater--and from the repeater (on F2) to the other mobile. Mobile-to-mobile communication is possible, at least in theory, when both mobiles are within range of the same repeater.



The problem arises when mobiles are close to each other, but distant from the repeater. Transmitter Noise (NS) and Receiver Desensitization (DS) rear their ugly heads. How close is "too close" and how distant is "too distant" are all variables. They depend upon transmitter power levels, the separation between the two frequencies, and the characteristics of the transmitters and receivers. If there is the slightest loss of receiver performance at F2 when a nearby transmitter is operated on F1 (and there will be such a loss in practice), you are set up for trouble! There will be places at the fringes of the repeater's coverage area where mobiles can communicate with mobiles across the county, but cannot communicate with mobiles which are within "eyeball range!" And, the worst case is when the mobiles are bumper-to-bumper. Explain that to a deputy sheriff (or to a governor)! With lower mobile transmitter power, higher repeater transmitter power or increased frequency separation, you move the trouble areas out farther from the repeater, but you don't get rid of 'em. They will exist--someplace!

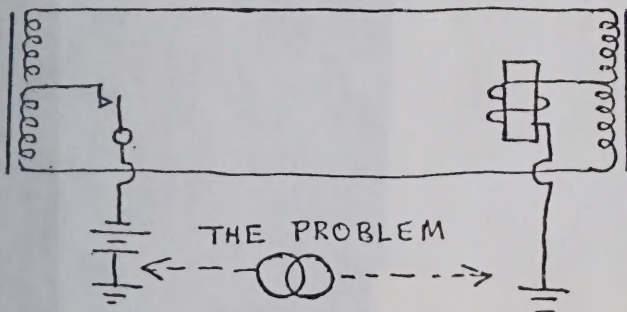
One corrective approach is system overdesign. You make the trouble areas fall far beyond the needed communication range. Murphy's Law controls as usual, however. It is only a matter of time until the user expands his prime operations into the area you planned to serve as a cushion.

Frequency separations and equipment design permitting, you can provide frequency switching for car-to-car communication in the problem areas. The mobile transmitters can shift to F2, or the mobile receivers can shift to F1. Both bring operational problems, since the user may not recognize the cause of his difficulty and know that frequency shifting is necessary. At least, you've improved the status from "impossible" to "difficult" and that is in the right direction!

* 4. DON'T ASSUME a receiver filtering deficiency just because you hear CTCSS tone in a receiver. Certainly, a low-frequency residual "buzz" in the receiver is an annoyance. Certainly, you'd like to be rid of it. And, although you may be short on reject filtering in the receiver, that's not the only possible cause. In fact, it's not even the most likely cause. Look for encoder distortion first. A distorted tone will drop harmonics across the audio passband at intervals equal to the tone squelch frequency. The "beats" between harmonics give you the sensation of the tone itself.

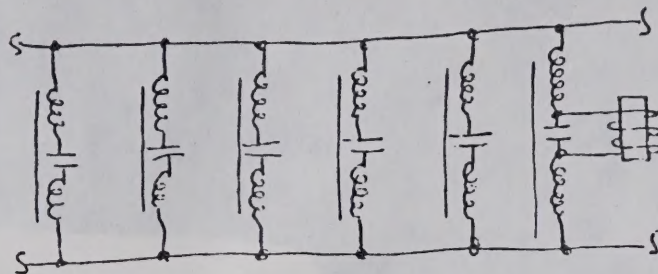
Check first with a harmonic distortion meter driven by a modulation monitor. If you measure more than a few percent, look for the cause. A distortion measurement at the encoder output will point to either encoder or modulator as the distortion source. If it is the modulator, the solution may be as simple as retuning the modulator, or reducing the encoder output to one the modulator can handle without distortion. In any event, work with the source (encoder and modulator) first before you tear into the receiving end.

5. DON'T IGNORE ground potential differences when you use simplex telephone line connections.



If you choose simplex (line-to-ground) control and "ground" is not at the same potential at both ends, you're a candidate for falsing of your control functions. Obviously, low current functions (such as those which operate at 2.5 mA) are the most vulnerable. And, solid state switches (which may be able to respond to noise at 60/120/180 Hz) are more likely to malfunction than are relatively sluggish relays. A high-pass filter ahead of the controlled device (with cutoff above 180 Hz) can settle down some unhappy situations. Otherwise, a line-to-line keying arrangement (composite) provides a way out.

6. DON'T PILE UP line split capacitors when you use line-to-line telephone hookups.



You have many remote control units in parallel across the same telephone line. Each one has the customary 4 uF line split capacitor. When one "keys" from a remote, nothing happens at the base station until all of the line split capacitors have taken their charge. And, when the remote is unkeyed, the station transmitter doesn't drop until the charge drains from all the capacitors. So, you have slow turn-on, and slow turn-off. Sometimes it seems that you need "thirty days written notice" of your intent to say something! And, when telephone lines are short and your "battery" is not current regulated, you can have your own fireworks at the control contacts. It takes a lot of current to charge up this "capacitor bank."

Rather than live with the situation, you can replace the line split capacitors with something much smaller than usual, say with values around 0.1 uF. This speeds things up, and gives keying contacts somewhat longer life expectancy. The effect on system audio response is usually beneficial, since a bunch of paralleled remote control units tend to roll-off the high audio frequencies.

CONTRIBUTIONS, ANYONE? This collection of "goofs" is far from exhaustive. Having made a few mistakes myself, and having followed a number of other practitioners of the art, I have plenty of material to start another article along this same line. Not having a corner on the market, though, I'll welcome your own "Ounce of Prevention" should you care to send it along.

--Kenny Guthrie

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